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ABSTRACT

The effectiveness of two variations of elaborative interrogation for group settings was investigated in an experiment in which 88 college students, aged 18 to 50 years, learned factual sentence information and responded, orally or in writing, to questions about the information. Subjects met in groups of eight to 12 members that were randomly assigned to one of two elaborative interrogation conditions, oral or written, or to a control condition. Stimulus materials were identical for all subjects across all three conditions. Each subject was provided with a booklet presenting six facts about nine different familiar animals with one fact on each page and presentation always in the same order. The interrogation strategy variations were compared to a challenging, ecologically valid control condition in which students were instructed to use whatever strategies they thought would work best for the sentence-learning task. Results indicate that the written and the oral variations of elaborative interrogation were equally effective and that both variations significantly enhanced the students' performance on an associative match task but not on a recall task. (Contains 15 references.) (Author/NAV)

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Elaborative Interrogation in Group Settings

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Abstract

The effectiveness of two variations of elaborative interrogation for group settings was investigated in an experiment where college students learned factual sentence information. The interrogation strategy variations were compared to a challenging, ecologically valid control condition in which students were instructed to use whatever strategies they thought would work best for the sentence-learning task. Results indicated that the written and the oral variations of elaborative interrogation were equally effective and that both variations significantly enhanced the students' performance on an associative matching task but not on a recall task.

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Elaborative Interrogation in Group Settings

At all levels of education, students are asked to learn associative factual information. Elementary school children, for example, need to remember the characteristics of various geographical regions of the United States, high school students study attributes of plants and animals, and medical school students must learn the effects of various chemicals on the organs of the body. In order to learn this type of material, students of all ages select methods based on trial and error, personal preference, or, less often, specific strategy instruction. A great body of educational research exists, however, documenting the efficacy of instructing students in the use of various memory strategies (e.g., Levin, 1993; McDaniel & Pressley, 1987; Weinstein, Goetz, & Alexander, 1988).

Responding to "why" questions about factual material is one strategy that has been found to facilitate memory performance. To illustrate, a student may be told that the emperor penguin lives only in Antarctica (Wood, Pressley, & Winne, 1990). Answering the question "Why do you think this is true?" will generally make the association more likely remembered, with the explanation produced being defined as an "elaboration." This strategy has been named "elaborative interrogation." The process of producing an elaboration is usually assumed to activate prior knowledge that would otherwise not be brought to mind, and subsequent learning benefits are attributed to the link created between the new information and the knowledge already present in long-term memory (Willoughby, Waller, Wood, & MacKinnon, 1993; Woloshyn, Pressley, & Schneider, 1992).

Because the asking and answering of questions are activities included in nearly any classroom regime, the strategy of elaborative interrogation would seem well-suited for the classroom environment. Teaching memory strategies to students means utilizing valuable instructional time as well as influencing, conceivably, their approach to learning tasks with similar demands long into the future. Therefore, in addition to assessing the effectiveness of elaborative interrogation, it is also important that we consider the best methods for strategy implementation in classroom settings, and whether or not use of the strategy will result in greater learning benefits for the students above what they would have gained from employment of their previously acquired, self-selected strategies.

The initial demonstration of the effectiveness of this type of elaboration was provided in research reported by Stein and Bransford (1979). These researchers constructed a series of "man sentences" that later came to be used as stimulus materials for much elaborative interrogation experimentation (Pressley, McDaniel, Turnure, Wood, & Ahmad, 1987; Pressley, Symons, McDaniel, Snyder, & Turnure, 1988; Wood, Fler, & Willoughby, 1992; Wood et al., 1990). The "man sentences" were constructed to represent an arbitrary connection between subject and action: for example, the hungry man got into the car, or the brave man ran into the house. Stein and Bransford discovered that

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precisely elaborated versions of these sentences (e.g., the hungry man got into the car to drive to the restaurant) were more easily remembered than the base sentences alone. In contrast, when the sentences were presented with imprecise elaborations (e.g., the hungry man got into the car and drove to school), the sentences became more difficult to remember, compared to recall of the base sentences alone. In a second experiment, Stein and Bransford (1979) further investigated the effect of elaboration. The same man sentences were used, with four experimental conditions. In addition to the two conditions in which the participants were provided with either precise or imprecise elaborations, participants in the third and fourth conditions were required to answer one of two types of questions about the sentences: "What else might happen?" or "Why might this man be engaged in this particular activity?" When memory of man-action associations was later tested, the asking of the "why" question was found to be as effective as providing a precise elaboration, with both of these conditions exceeding the effectiveness of the other two.

When they first began to extend elaborative interrogation research into educational settings, Pressley et al. (1988) recognized that school learning, at all levels, frequently involves associating many responses to one stimulus, different from the item-by-item associations of the man sentences. Therefore, they constructed two new sets of stimulus materials. One set consisted of Canadian provinces and related facts to be presented to Canadian students (e.g., the first schools for the deaf were established in Quebec), and the other assigned general characteristics to males, females, or both sexes (e.g., more surgeries are performed on women). When compared to a reading control, elaborative interrogation was found to be as effective with these more ecologically valid materials as previously found with the man sentences. Other research investigated the quality of the students' elaborations and found that the probability of the learner's success in later remembering the related items varied little with respect to the type of elaboration generated (Pressley et al., 1987; Willoughby, Waller, Wood, & MacKinnon, 1993; Woloshyn, Pressley, & Schneider, 1992; Woloshyn, Willoughby, Wood, & Pressley, 1990). Other findings in this area, however, have been obtained with younger age groups (Kahl, 1993; Wood, Pressley, & Winne, 1990).

In all of the above mentioned research, the elaborative interrogation procedure was administered individually. Research participants worked one-on-one with a researcher, being taught and practicing the strategy. Wood, Fler, and Willoughby (1992) extended this research to group administrations of elaborative interrogation where college students working alone were asked to write down their responses to the why questions. Strategy instruction was provided to groups of 5 or 20 individuals. The results indicated that use of elaboration interrogation had a positive effect on memory performance and that the effectiveness of elaborative interrogation did not vary with group size. In

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addition, Kahl (1993) found that sixth-grade students in cooperative learning groups could be trained to use the strategy effectively. Both of these studies have helped to advance elaborative interrogation research out of the laboratory and closer to the applied classroom setting.

Upon review of existing elaborative interrogation research, two general areas seemed in need of further investigation. First, it appeared necessary to further extend elaborative interrogation research into settings more similar to classrooms by utilizing group administrations. More specifically, will elaborative interrogation have beneficial effects if college students respond aloud, sharing their elaborations with other students? The second area concerns the nature of the comparison control condition. In all studies cited above, elaborative interrogation was compared to a repetition or "read to understand" control. Both of these types of control conditions required the participants to read or repeat the information over and over until time was up, and a significant performance advantage in favor of elaborative interrogation was obtained. Wood and Hewitt (1993), however, compared memory performance of high achieving fifth- and sixth-grade students, using three experimental conditions: elaborative interrogation, spontaneous strategy, and repetition control. Using the animal materials (Wood et al., 1990) and individual administration, their results showed that the higher-achievers were equally successful using either elaborative interrogation or their own spontaneously chosen strategy. Furthermore, both of these conditions significantly outperformed the repetition control. From these results, the experimenters concluded that high achieving students ordinarily utilize comparatively sophisticated strategies; thus, elaborative interrogation instruction did not provide them with a memory advantage. How would college students fare when given the opportunity to "use whatever works best" and encouraged to use memory strategies that they have found useful in previous learning situations?

Method

Participants and Design

The participants in this study were 88 college students (71 females and 17 males) enrolled in psychology classes at a midwestern university. They ranged in age from 18 to 50 (M=20.3 years, SD=3.7). When asked to indicate their race/ethnicity, 98% identified themselves as white, nonHispanic, and 2% as Asian or Pacific Islander.

The participants met in groups ranging in size from 8 to 12 members that were randomly assigned to one of two elaborative interrogation (EI) conditions, EI-oral and EI-written, or to a control condition. A total of 34 students (27 females and 7 males) participated in the EI-oral condition, 28 students (21 females and 7 males) participated in the EI-written condition, and 26 students (23 females and 3 males) participated in the

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control condition. The same two female experimenters administered, together, all of the treatment sessions.

Materials and Procedure

Stimulus materials for this study were identical for all participants across all three conditions. Each student was provided with a booklet (14 cm x 21.5 cm) presenting six facts about nine different familiar animals, for a total of 54 facts in sentence form. One fact was presented on each page, always in the same order. Facts used were those first constructed and utilized by Wood et al. (1990) and also used in other, subsequent elaborative interrogation experiments (Kahl, 1993; Willoughby et al., 1993; Wood et al., 1992). The nine animals used in the present study were those deemed "familiar" by the previous researchers, with one exception. Because "American Pika" lives only in British Columbia, it could not be considered familiar to midwestern United States residents. Therefore, six facts about a cottontail rabbit were constructed as a replacement, following the same pattern of characteristics (physical habitat, diet, sleep habits, and major predators) as the original materials. In addition to being provided with the booklet, all participants also heard the facts read aloud. The instructions for the experiment were presented orally, with three sample sentences constructed for practice in all conditions.

The experiment was administered to groups of 8 to 12 students in regular university classrooms. All participants were assigned a subject number that was attached to their desks. After reading and signing a consent form, the participants filled out a brief personal data sheet that requested age, gender, year in school, and racial/ethnic background. Instructions were then read aloud to each group. Reading of the instructions took approximately the same length of time for all conditions.

EI-written condition. The students were told that the purpose of the experiment was to see how well people could learn sentences and that they would be presented with six facts about nine different animals. They were told that they would need to answer one question following each sentence, something like "Why does that animal do that?" It was explained that answering the question would help them to remember and that later they would be tested on the information. They were told to write down their answers in the booklet directly beneath the stimulus statement.

Pieces of plain white paper were distributed, and the three practice sentences were first presented. The primary experimenter first read aloud a practice sentence, asked the "why" question, and allowed 18 seconds for the students to write down their answers. The experimenter then asked for a volunteer to share his or her answer, after which feedback was given. More specifically, if the elaboration offered was a good one, the student was told so. If the elaboration volunteered did not specifically answer the why question, this discrepancy was pointed out. In either case, the experimenter then offered "two answers that I thought of" and then invited questions regarding implementation of the strategy. Following similar presentation

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of two more sample sentences, a practice memory test was administered orally.

Participants were encouraged to try hard to answer the questions, and the presentation of the 54 facts began. The primary experimenter read the sentence, asked the question, waited 18 seconds while students wrote down their answers, and then told them to turn the page. The procedure was repeated through the 54 pages of the booklet.

EI-oral condition. The students were told the same purpose of the experiment as were those in the EI-written condition, and they were given the same explanation of the elaborative interrogation technique. The EI-oral students were told that they would be called on, by subject number, to answer the "why" question orally, and that everybody would get approximately the same number of turns to respond. The sessions were tape-recorded and the secondary experimenter also wrote down each oral response. The same three practice sentences were presented, with the experimenter reading the sentence aloud, asking the "why" question, and waiting 5 seconds before calling on a student to respond. In order to encourage all students to generate an answer to each question, they were called upon in random order. A total of 18 seconds was allowed, with timing beginning immediately after the question was asked. The experimenter then offered feedback to the practice response and the same "two answers that I thought of" as with the EI-written condition. Following similar presentation of the other two practice sentences, memory of the facts was tested, and the stimulus materials were distributed.

Participants were again encouraged to try hard, and the experimental procedure began. The experimenter read the sentence, asked the question, and waited 5 seconds. An individual was then called upon to respond, and after 18 total seconds, the students were told to turn the page. Each EI-oral student received approximately six turns to respond orally.

Control condition. Participants assigned to the control group were also told that the purpose of the experiment was to see how well people could learn sentences. They were told about the 54 animal facts, for which they were to use "any method" to remember. It was suggested that they had probably had to remember similar things in the past, and that they should do whatever they thought would work best. The control students were also told that their memory of the facts would be assessed following the presentation. The three sample sentences were presented, with the experimenter reading each sentence out loud, telling them "try hard, right now, to remember this" and allowing 18 seconds for study. The practice memory test followed.

The booklets were then distributed and the students were reminded that it was up to them to use the method that they thought would work best. The 54 facts were then presented, with the primary experimenter reading each sentence, waiting 18 seconds, and telling them to turn the page.

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All conditions. In all three conditions, after the 54 facts were presented, the experiment proceeded identically. As a distractor task, a jumbled word test was next distributed. Participants were given 3 minutes to unscramble as many of the five-letter familiar words as possible on a list of 104. Time and attention spent on this task was intended to allow the last sentences presented to decay from short-term memory.

Next, the recall test was administered. Directions for the recall test asked the students to write down as much information about each animal as they could remember. The names of the animals were provided, with six blank lines beneath each. Participants were given as much time as they needed to work on the test, with the associative matching test distributed as each person finished. The matching test provided sentences representing all 54 of the facts. Names of the animals were listed, with a letter of the alphabet assigned to each one. Items were presented in random order, written as "This animal only eats about three months of the year," followed by a short blank line for the student's response.

Upon completion of the matching test, an end-of-experiment questionnaire was distributed as a final step. On the questionnaire, participants in all three conditions were presented with the same two of the 54 facts. They were then asked, "How did you learn this? What did you do? What did you think of?" Four blank lines were provided for their open-ended responses. Students in the control group were presented a third and final question, asking how, in general, they went about learning the material. Students in the EI-oral and EI-written conditions were asked to estimate for how many facts, out of the 54, they thought of an answer to the "why" question. In addition, both of the elaborative interrogation groups were asked to rate the likelihood of their using the strategy in the future, as well as their enjoyment of it.

Results

A total of 94 students participated in the study, with data provided by six of them being excluded from the analysis. One student in the EI-written condition was given a defective booklet, with one page missing, and five students in an EI-oral condition administration did not follow directions given: They wrote down some of their responses although they had been instructed not to do so.

In order to assure that the recall tests were scored "blindly" with respect to performance and experimental condition, all participants' responses were combined on separate sheets of paper. Responses were then awarded full credit (1 point), half credit (.5 point), or no credit. Scoring was done jointly by the two experimenters, with differences resolved by discussion. In determining points awarded, it was not considered necessary for students to recall the facts verbatim. In all cases, a paraphrasing conveying the essential information was awarded full credit. Criteria were established for each item, specifying elements required for full and half credit. For example, in

scoring recall of "Rabbits have so many enemies that most babies do not survive," a full credit response mentioned the prevalence of early deaths and, also, that the babies were killed by other animals. For instance, "predators eat most of young" received full credit, while "most babies do not survive" was awarded half credit. Individual response scores were then transferred back to participants' test protocols and totalled.

The effect of experimental condition on the recall and associative matching measures was tested by means of three planned pairwise directional comparisons, using the Holm sequential Bonferroni procedure (Holm, 1979) with a family-wise Type I error probability of .05. The critical t's for the first, second, and third comparisons were 2.08, 1.99, and 1.67, respectively, with degrees of freedom equal to 85.

The mean percentage of facts correctly recalled and matched are displayed, according to condition, in Table 1. On the recall test, both the EI-oral and EI-written groups descriptively outperformed the control group, although not at a level of statistical significance, t's < 1. On the matching test, however, both EI-oral and EI-written groups significantly outperformed the control group, t=2.45 and 1.99, respectively. In addition, the EI-oral and EI-written conditions did not differ significantly from each other.

Insert Table 1 about here

Supplementary data collected by means of the end-of-experiment questionnaire supported the assumption that the majority of EI-written and EI-oral students were indeed complying with the strategy instruction. The analysis of questionnaire responses is summarized in Table 2 for the EI-written and EI-oral conditions. Responses to the open-ended questions were categorized by the experimenters with the number of responses fitting each category being represented by a percentage of the

Insert Table 2 about here

total responses. When asked how they went about learning the example statements, between 64% and 74% of the EI-written and EI-oral students clearly indicated that they had followed strategy instructions. However, it may be possible to assume that those who offered no description of any processing (e.g., "I forgot that" or "I learned it from the booklet") did comply, overall, with the elaborative interrogation strategy instruction. This seems likely considering that when EI-oral participants were called on to respond, only two questions, in total, went unanswered, and these two were directed at the same individual. In nearly every instance, EI-oral students responded immediately upon being called by subject number. This seems to indicate that they were following the experimental directions during the 5-second wait time, activating their prior knowledge and preparing to answer the question. In addition, examination of the booklets

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used by EI-written students also seemed to indicate nearly complete compliance with the instructions. Four booklets of the 28 used by EI-written participants lacked a written response on one or two of the pages. All others contained a response on every page.

In addition, the data collected by the questionnaire supports the contention that the control group was, indeed, an ecologically valid one. A summary of the control students' responses are presented in Table 3. Again, students' responses

Insert Table 3 about here

to the questions were categorized and represented as percentages of responses falling within each category when compared to total number of responses. When presented with the two example facts from the stimulus materials, between 8 and 12% of the controls indicated that they used repetition only. In response to the question that asked how they approached learning the facts, in general, 20% indicated that they had used only repetition. All other categories, with the exception of "no description", indicate strategies that are typically considered to be more powerful than repetition, such as associating key words using imagery and connecting the to-be-learned material to prior knowledge. It should be pointed out that this latter strategy of creating connections with prior knowledge was exactly what the elaborative interrogation students were asked to do for all of the items.

On the end of experiment questionnaire, participants in EI-written and EI-oral groups were also asked "For how many facts, out of the 54, did you think of an answer to the 'why' question?" The mean number of facts reported by EI-written students was 44.11 (SD=10.09), while the mean for the EI-oral group was 42.52 (SD=11.14). When these mean estimations were compared, there was no significant difference between the EI-written and EI-oral groups. When asked how likely they were to use the strategy in the future, 64% of the students in the EI-written condition responded that they were somewhat or very likely to do so, compared to 88% of the EI-oral students. In answer to how much they had enjoyed using the strategy, 89% of the participants in the EI-written condition responded "somewhat" or "very much" compared to 97% of the EI-oral students. Judging by anecdotal observations and feedback received after the experiment, some of the EI-written students apparently felt quite pressed for time in needing to record their responses within 18 seconds. Perhaps this accounted for the slight difference between groups in attitude toward the strategy.

Discussion

The results of this study indicate positive effects when students are taught to use elaborative interrogation in small

classroom-like settings. Working in groups of 8 to 12, students in both oral and written elaborative interrogation conditions significantly outperformed the control condition on the associative matching test.

The analysis of the students' memory performance showed that elaborative interrogation was more effective for associative matching than for a task that required the facts to be recalled when provided only with the names of the animals. Most previous elaborative interrogation experiments have used performance on a task such as associative matching, "fill in the blank," or cued recall (e.g., "Which animal never makes a home or nest to live in?") for a dependent measure. The recall test used in the present experiment is a much more difficult task, overall, when compared to these other measures. Woloshyn et al. (1990) used a recall test similar to the one in the present study for assessing the memory performance of college students who learned facts about Canadian universities. These investigators found that elaborative interrogation provided a significant advantage on the recall test as compared to control condition, but it should be pointed out that the students in their control condition were required to read each fact out loud repeatedly during the entire presentation interval. The lack of a significant advantage on the recall task of the present experiment can likely be explained by the relatively more effective self-selected strategies utilized by the students in the control group.

A major intent of the present study was to investigate the effectiveness of elaborative interrogation when instructed, practiced, and utilized in group settings, in order to help advance memory strategy research into more naturalistic classroom situations. Small and large group administration had previously been found to be as effective as individual administration by Wood et al. (1992), when compared to a repetition control. The more recent investigation of Kahl (1993) extended the research into cooperative learning settings to find that elaborative interrogation facilitated memory performance when compared to a repetitive reading control. The present experiment's oral format introduced a new challenge, as it provided less opportunity for participants to communicate and explain the reasoning behind the answers to their "why" questions, and this explaining process is often credited, in part, for elaborative interrogation's effectiveness (Pressley & Bryant, 1982).

In addition, concerns about students' responses interfering with one another appear to be unfounded. Although elaborative interrogation has been found to be more effective than simply providing learners with precise elaborations (e.g., Pressley et al., 1987), the results of the present study seem to indicate that once learners have activated and searched their own prior knowledge, hearing a response that may differ from or even conflict with their own reasoning does not negate the benefits of the elaborative interrogation technique. The beneficial effects in the EI-oral condition may not have been identified, however,

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without the experimental procedure including the 5-second wait period. Based on the questionnaire responses, we can confidently assume that during this time, the majority of students were compliantly considering the question.

The significance of this experiment can be best appreciated when considering that elaborative interrogation was compared to a challenging, ecologically valid control condition. Rather than encouraging control students to chose whatever method they think would work best, most previous elaborative interrogation experiments have used some type of repetition or reading control (Kahl, 1993; Martin & Pressley, 1991; Pressley et al., 1987; Pressley et al., 1988; Woloshyn et al., 1990; Woloshyn et al., 1992; Wood et al., 1990; Wood & Willoughby, 1992; Wood et al., 1992). Based on information generated by our end-of-experiment questionnaire, it is clear that the majority of control students in this study attempted to employ fairly sophisticated strategies. To have instructed this same group of learners to simply read or mentally repeat the materials over and over within the time limit would likely have deflated most of their performances. By encouraging them, instead, to use any strategies that had worked well for them in the past, elaborative interrogation was measured against an optimal performance.

Having broadened the possibilities for the application of elaborative interrogation techniques, the positive results of this study generate a number of questions for further research. With an oral variation of elaborative interrogation found to be effective in group settings of college students, it would now be informative to investigate the effectiveness of similar group implementation with younger learners. A developmental study comparing, for example, younger and older elementary students could aid in formulating recommendations for classroom applications. In addition, it would be valuable to experiment with providing strategy instruction in actual classrooms with materials that are part of the school's curriculum.

Other important questions need to be addressed that concern the nature of the learning outcomes. Researchers have consistently found that elaborative interrogation enhances associative memory performance. However, other learning benefits may be occurring. Successful implementation of the elaborative interrogation strategy requires the learner to comprehend the new material, to analyze previously acquired information (prior knowledge) to identify relationships with the new material, and then to select relevant information from prior knowledge when formulating a response to the "why" question. Consequently, it seems quite likely that elaborative interrogation would also facilitate performance on measures that tap comprehension, application, and analysis, among others. Therefore, we would strongly encourage strategy researchers to direct their attention to learning outcomes in addition to memory performance. Students of all ages need to learn a wide array of materials and to acquire a number of different cognitive skills; they deserve to

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receive well-informed recommendations on the best strategies for optimal performance.

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Table 1
Percentages of Correct Responses on Recall and Matching Tests as a Function of Condition

Experimental condition	Recall		Matching	
	M	SD	M	SD
EI-oral	52.97	16.29	79.68	11.88
EI-written	52.71	16.34	78.51	10.50
Control	47.22	18.73	71.87	14.31

Table 2
Percentages of Types of Strategies Reported to Have Been Used by EI Students

Type of Strategy Reported	Written		Oral	
	[a] Q1	[b] Q2	[a] Q1	[b] Q2
Followed EI instructions precisely	64	64	74	68
No description provided (e.g., "I forgot that")	22	14	12	12
Imagery strategies (e.g., imagery, imagery + repetition)	14	11	6	15
EI + imagery	0	11	3	6
Listening to others' responses	0	0	6	0

[a] "The emperor penguin never makes a nest or a home to live in." How did you learn this? What did you do? What did you think of?"
[b] "The house mouse eats nuts, vegetables, fruits, and grains." How did you learn this? What did you do? What did you think of?"

Table 3
Percentages of Types of Strategies Reported to Have Been Used by Control Students

Type of Strategy Reported	[a]Q1	[b]Q2	[c]Q3
Repetition only	12	8	20
Visual imagery	16	8	16
Connection to prior knowledge	20	12	0
Grouping, accumulating, or relating to self	4	8	12
Repetition + visual imagery	8	4	24
Connection to prior knowledge + repetition or imagery	16	12	4
Associating key words with or without imagery or grouping	12	12	24
No description provided (e.g., "just remembered")	12	4	0

[a]"The emperor penguin never makes a nest or a home to live in." How did you learn this? What did you do? What did you think of?
[b]"The house mouse eats nuts, vegetables, and grains." How did you learn this? What did you do? What did you think of?
[c]In general, how did you try to learn the material?